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Operative Approach in Traumatic Injuries of the Duodenum

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Key words. Trauma ; duodenal injury.

Abstract. *Background :* The management of duodenal traumas remains controversial. The experience of Ankara Numune Training and Research Hospital Emergency Surgery Department with duodenal injuries during a 10-year period was analyzed to identify trends in operative management and sources of duodenum-related morbidity and mortality.
Methods and Results : Between 1994 and 2003, 1799 patients with blunt abdominal trauma were operated on and the incidence of duodenal trauma was 2.8% (50 patients). The injuries were penetrating in 31 (62%) patients and blunt in 19 (38%). Primary repair (PR) of injury was performed in 24 (48%) patients, primary repair and tube duodenostomy (PRTd) in 8 (16%) patients, complex repair (CR) in 11 (22%) patients, and exploration only without a duodenal procedure in 5 (10%) patients. Two of the patients died during laparotomy. The mortality rate was 12% and the incidence of duodenum-related morbidity was 12%. The overall morbidity rate was 40% (20 patients). The most commonly injured portion of the duodenum was DII (58%), and the most frequent cause of duodenum-related and overall morbidity in our series was Grade III duodenal injury.
Conclusion : Our experience suggests that the use of primary repair in grade III injury may be associated with higher duodenum-related morbidity. Our recommendation is to use complex repair for grade III duodenal injuries.

Introduction

Unlike other injuries of the gastro-intestinal tract, the management of duodenal injuries has remained controversial among trauma surgeons. The retroperitoneal location of the duodenum, its proximity to important abdominal structures, its marginal blood supply, the biliary, pancreatic and gastro-intestinal secretions it contains, and delays in the diagnosis of its injuries, cause therapeutic difficulties. Furthermore, all these factors create intra-operative dilemmas in the surgical management of duodenal injuries. In this study, we retrospectively analyzed our experience with duodenal injuries and investigated the value of different surgical approaches. We also tried to describe sources of duodenum-related morbidity and mortality.

In addition, the various reports do not deal with the relationship between the grade of duodenal injury and operative choices. We therefore tried to identify trends in operative management in our emergency surgery department and analyzed the relationship between severity and surgical approach in our series.

Patients and method

Between January 1994 and November 2003, 50 patients with duodenal injuries were treated at the Department of Trauma and Emergency Surgery of Ankara Numune Training and Research Hospital. The definitive diagnosis of duodenal injury was obtained at laparotomy in all patients.

All data were collected from hospital patients' records retrospectively. For each patient, the following data were recorded from the documents : age, sex, grade of duodenal injury, number and size of lesions, anatomic location of duodenal injury, associated abdominal organ injuries, surgical procedures performed, presence and type of complications and duodenum-related morbidity and mortality. All operations were performed in the operating theatres of the Trauma and Emergency Surgery Department of Ankara Numune Training and Research Hospital by the surgical team on call.

Duodenal injuries were classified in all patients (1) as grades I to V using the duodenal organ injury scale (DIS) according to AAST (American Association for the Surgery of Trauma) (Table I).

The duodenal injury repair methods used were primary repair (PR), primary repair with tube duodenostomy (PRTd) and complex repair (CR). PR was defined as simple closure of the duodenal perforation with absorbable suture materials. PRTd was defined as simple closure of the duodenum and placement of a tube into the duodenum for decompression. CR implied a variety of methods including pyloric exclusion, pancreaticoduodenectomy, triple ostomies with duodenal repair and/or tube duodenostomy.

Morbidity was analyzed as duodenum-related and general morbidity. Mortality was defined as in-hospital

Table I

Duodenum Organ Injury Scale According to AAST (American Association for the Surgery of Trauma)

Grade		Injury Description
I	Haematoma	Involving single portion of duodenum
	Laceration	Partial thickness, no perforation
II	Haematoma	Involving more than one portion
	Laceration	Disruption < 50% of circumference
III	Laceration	Disruption 50-75% of circumference of D2
		Disruption 50-100% of circumference of D1, D3, D4
IV	Laceration	Disruption > 75% of circumference of D2
		Involving ampulla or distal common bile duct
V	Laceration	Massive disruption of duodenopancreatic complex
	Vascular	Devascularization of duodenum

D1 : 1st portion ; D2 : 2nd portion ; D3 : 3rd portion ; D4 : 4th portion of duodenum.

mortality. None of the patients died after discharge from the hospital.

Results

During a 10-year period, the incidence of duodenal trauma was 2.8% (50 patients) among 1799 abdominal trauma patients operated on at the Ankara Numune Training and Research Hospital Emergency Surgery Department. According to the cause of trauma, the duodenal injury incidence rate was 2.2% (19 patients = 15 traffic accidents + 2 falls from high places + 2 other blunt trauma) among operated blunt abdominal trauma cases (869 patients = 756 traffic accidents + 78 falls from high places + 35 other blunt trauma) and 3.3% (31 patients = 22 gunshot wounds + 9 stab wounds) among operated penetrating abdominal trauma cases (930 patients). In the study group, 11% (22 patients) of the 200 gunshot wound cases had associated duodenal injury, while this rate was only 1.2% (9 patients) among 730 stab wound patients.

Predictably, the patients were mostly young with an average age of 29.9 years (range 16-70 years). There was a male predominance, with 42 males (84%) and 8 females (16%). The mechanism of injury was knife stab wound in 9 (18%) patients, gunshot wound in 22 (44%) patients and blunt injury in 19 (38%) patients (Table II).

Ten patients (20%) had haemorrhagic shock on first admission to the emergency room. Two (4%) of these 10 patients died peroperatively. One patient died because of multiple organ dysfunction syndrome (MODS) following duodenal fistula. There was no mortality or morbidity among the remaining seven patients.

Table II

Patients' demographics and injury characteristics

	Number of patients'	%
Gender		
Female	8	16%
Male	42	84%
Age	16-70 (mean 29.9)	
Injury Mechanism		
Blunt	19	38%
Traffic accident	15	30%
Fall from high place	2	4%
Other blunt trauma	2	4%
Penetrating	31	62%
Gunshot	22	44%
Stab wound	9	18%
Shock at first admission	9	18%
Duodenal injury severity		
Grade I	5	10%
Grade II	28	56%
Grade III	14	28%
Grade IV	1	2%
Grade V	2	4%
Isolated duodenal injury	7	14%
Duodenum + other organ injury	43	86%

In the group, 43 patients (86%) had injuries to other abdominal organs. The injured abdominal organs are presented according to the mechanisms of trauma in Table III. Only 7 (14%) patients had isolated duodenal injuries. The most commonly associated injured organ was the liver (in 23 patients), with other injured organs being the stomach in 19 patients, colon in 18 patients and pancreas in 10 patients. Fifteen patients (30%) had extra-abdominal injuries.

The clinical data of the patients, according to the grade of duodenal injury severity (DIS) and the mechanisms and anatomic localization of the injury are presented in Table IV.

The performed duodenal injury repair methods and morbidity and mortality results of the patients are presented in Table V. The great majority of duodenal injuries were managed by primary repair (24 patients : 48%) in the first operation. Silastic soft sump abdominal drains were used in all patients and the drains were primarily placed in the subhepatic, periduodenal space through another clean stab wound.

Grade I injuries occurred in 5 (10%) patients, most of them caused by blunt injury (4 patients, 80%) and no duodenal procedure was required. Most of the patients had grade II (28 patients, 56%) or III (14 patients, 28%) duodenal injuries. Penetrating injuries accounted for 38% (19 patients) and 20% (10 patients) of the grade II and III injuries, whereas blunt injuries accounted for 18% (9 patients) and 8% (4 patients) respectively.

The duodenum-related and overall morbidity rate was highest for Grade III duodenal injuries. When the first

Table III

Associated Abdominal Organ Injuries

	Gunshot	Stab Wound	Blunt Trauma	Total
Liver	15	3	5	23
Stomach	14	4	1	19
Colon	13	4	1	18
Pancreas	2	3	5	10
Gallbladder	4	2	3	9
Small Bowel	7	1	–	8
V. Cava Inf.	4	3	–	7
Kidney	4	–	1	5
Retrop. Haematoma	1	2	2	5
Spleen	–	–	3	3
V. Porta	–	1	1	2
V. Mesenterica Sup.	1	–	1	2
A. Hepatica Dext	1	–	–	1
Diaphragm	1	–	–	1

operative choice was primary repair for grade III injury, the rate of duodenal fistula was higher than with the CR / PRTd methods. All grade III injuries repaired with PR were re-operated and converted to PRTd or CR as a secondary or tertiary procedure. A total of 16 operations were performed on 5 cases with grade III duodenal injuries where the first operative choice was PR.

The other morbidity causes were liver abscess, pleural effusion, pneumonia, adult respiratory distress syndrome (ARDS), colonic anastomosis dehiscence, intra-abdominal abscess, wound infection, sepsis, multiple organ dysfunction syndrome and stricture of the vena cava inferior. The mortality rate was 12% and correlated neither with the severity nor the mechanisms of duodenal injury ($p > 0.05$; Chi square test).

Discussion

The relatively low frequency of duodenal trauma compared to injuries of other abdominal organs and the high probability of the development of causes of morbidity such as fistula formation and sepsis after its repair has made this entity a challenging problem. The collection of a sufficient number of patients for meaningful analysis takes many years. We report the experience of our referral trauma centre with 50 duodenal injuries during a ten-year period. The injury classification was based upon the severity of duodenal injury and the

Table IV

Clinical data of duodenal trauma patients related with DIS*

	Grade I (n= 5)	Grade II (n= 28)	Grade III (n= 14)	Grade IV (n= 1)	Grade V (n= 2)	TOTAL (n=50)
Blunt	4 (8%)	9 (18%)	4 (8%)	1 (2%)	1 (2%)	19 (38%)
Penetrating	1 (2%)	19 (38%)	10 (20%)	0	1 (2%)	31 (62%)
A) Gunshot	0	15 (30%)	6 (12%)	0	1 (2%)	22 (44%)
B) Stab wound	1 (2%)	4 (8%)	4 (8%)	0	0	9 (18%)
D I	0	4 (8%)	0	0	1 (2%)	5 (10%)
D II	5 (10%)	16 (32%)	6 (12%)	1 (2%)	1 (2%)	29 (58%)
D III	0	3 (6%)	3 (6%)	0	0	6 (12%)
D IV	0	4 (8%)	2 (4%)	0	0	6 (12%)
D More than one portion	0	1 (2%)	3 (6%)	0	0	4 (8%)

*DIS : Duodenal injury severity.

Table V

The performed duodenal injury repair methods and morbidity-mortality

	Grade I (n = 5)	Grade II (n = 28)	Grade III (n = 14)	Grade IV (n = 1)	Grade V (n = 2)
PR	0	18 (64, 3%)	6 (46, 2%)	0	0
PRTd	0	7 (25%)	1 (7, 6%)	0	0
CR	0	3 (10, 7%)	6 (46, 2%)	0	2 (100%)
No duodenal Procedure	5 (100%)	0	0	0	0
Shock	0	4 (8%)	3 (6%)	1 (2%)	1 (2%)
Died before repair	0	0	1(2%)	1 (2%)	0
D-related morbidity	0	1 (2%)	5 (10%)	0	0
Duodenal fistula	0	1 (2%)	5 (10%)	0	0
Overall morbidity	1 (2%)	6 (12%)	13 (26%)	0	0
D*-related Mortality	0	1 (2%)	2 (2%)	0	0
Overall mortality	0	1 (2%)	4 (6%)	1 (2%)	0

*D : Duodenum.

anatomic location (1). Morbidity and mortality were evaluated according to the DIS and operative technique.

Grade I injuries occurred in 5 (10%) patients. Most of these (80%) were caused by blunt injury and duodenal surgical procedures were not required. These were found incidentally at laparotomy performed for other injuries. Therefore, only duodenal injuries which required operative management were evaluated in this report.

In our study, the majority of operations were PR (48%). When the first operative choice was PR, the fistula rate was 83.3% (5 of 6 patients) in grade III injured patients. When the first operative choice was CR or PRTd in grade III injured patients, there was no duodenum-related morbidity. Our findings are in contrast to those of Cogbill *et al.* (2). They claim that the tube duodenostomy was neither routinely necessary nor effective in preventing duodenum-related complications in their multicentre trials. We found that PRTd prevented duodenum-related morbidity in grade III injuries when compared with PR.

Severe associated injuries are almost always present with duodenal injury. It could be suggested that duodenal injuries play a marker role for injury severity. Our evaluation confirmed that more severely injured patients are at higher risk for postoperative extra-duodenal morbidity. While the rate of overall morbidity was found to be 40% in the study group, the rate of duodenum-related morbidity was only 12%. Our overall morbidity rate (40%) was parallel to other reported morbidity rates of 18%-49% (2, 3). In the literature, duodenal fistula rates range from 0 to 16.2% (4-7) while our fistula rate was 12%. The mortality rate is 10% to 29% in the literature (2, 5, 8-10) and 12% in our series.

We believe that complex repair has an important role in the management of duodenal injuries. Although the majority of patients can be safely managed by primary repair, we believe that grade III duodenal injuries require duodenal decompression or complex repair. Ivatury *et al.* found that using decompressive enterostomy and a serosal patch might be associated with higher morbidity (11). Complex repair is time-consuming and technically challenging. On the other hand, primary repair in patients with extensive duodenal trauma, who could tolerate more extensive procedures on the basis of their physiologic condition, may not be ideal for reducing postoperative duodenum-related morbidity/mortality.

Furthermore, blunt and penetrating duodenal trauma should be considered independently, because the risk factors and mechanisms are different. Kunin *et al.* advised the use of CT to differentiate duodenal injuries that require surgery from those that do not, in patients with blunt abdominal trauma (12) ; however, we diagnosed all our patients at laparotomy.

Deciding on the optimal operation for duodenal trauma may be difficult. The surgeon is confronted with the dilemma of either using simple repair methods, which may prove inadequate for the magnitude of the injury, or performing complex repairs, which may prolong the operation or simply be excessive. Although the precise indications for using more complex procedures than PR for duodenal injuries cannot be defined by this retrospective analysis, it seems that CR should not be avoided in favour of simple repairs in more severe injuries.

In conclusion, we found that the majority of duodenal injuries could be managed by primary repair. The most common duodenal injury mechanism was penetrating trauma due to gunshot, the most common injured portion of duodenum was DII, and the highest duodenum-related and overall morbidity rate was in grade III duodenal injury. Our experience suggests that the use of primary repair in grade III injury can be associated with higher duodenum-related morbidity, and our recommendation is to use complex repair for grade III duodenal injuries.

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